NAME : "PETRU PONI" INSTITUTE OF MACROMOLECULAR CHEMISTRY

INSTITUTION : ROMANIAN ACADEMY

COUNTRY : ROMANIA

Profile :
The "Petru Poni" Institute of Macromolecular Chemistry (PPIMC) is an Institute of excellence of the Romanian Academy. Established in February 1949, the Institute has a long tradition of over fifty years in fundamental and applied research in organic and inorganic chemistry, polymer chemistry and physics. For many years, the Institute is in the first line of Romanian research and covers practically the whole area of polymer science and technology, as well as of polymeric materials. Two important innovative activities are developed by the research staff, namely a scientific one, reflected in publications in macromolecular and organic chemistry, biochemistry, physical chemistry, biology, physics and materials science, and a technological one, dedicated to technology transfer and industrial implementation of the original research. 284 persons, including 2 members of the Romanian Academy, 109 researchers, 56 PhD students and 119 technical/administrative personnel are working in the Institute, the personnel under 35 years representing more than 25 %. PPIMC functions as a coordinator for joint national and international projects and was appointed by the Romanian Ministry of Education and Research as a Regional Contact Point for FP6/FP7 and ERA-MORE.

Activities :
- Basic research in polymer chemistry and physics, macromolecular materials: fundamental research on the synthesis and development of new synthetic monomers and polymers with special properties and applications, chemical modification of natural polymers, obtaining of bioactive and biocompatible polymers, designing of new techniques for the preparation of macromolecular compounds (reaction and polymerization mechanisms, combined techniques, ecologic and controlled processes) in order to develop new, high added value materials
- Applied research. Technology transfer. Small scale production - designed for the development of industrial technologies for different types of polymers and specialty polymeric materials
- Education in polymer science: general training activities, post graduating specialization achieved through doctoral degrees under the scientific guidance of the promoters from the Institute, and also specialised continuing education, organisation of workshops and conferences
- Service: consultancy in the synthesis and processing of polymeric materials, transfer of knowledge activities, certification for polymeric materials, consulting/assistance and cooperation for the improvement of human resources, solving of fundamental and technological problems on the synthesis, properties, processing and application of macromolecular compounds, solving of environment problems.

Expertise on following materials :

- polymers and biopolymers
- polymer composites
- ceramic materials
- wood and wood-based materials
- "green" polymers
- biofilms
- nanomaterials

Actual research domains concerning materials technology / Competences :

PROGRAMMES

I. New synthetic polymers - ***Silicon - based monomers and polymers***

- organohalogensilanes; organolithium and carbosilane precursors of polycarbosilanes; linear and cyclic functional carbosiloxanes; polysilanes
- macrocyclic heterosiloxanes as precursors for ceramic materials or carriers for liquid membranes; coordination polymers
- well-defined silico- and organofunctional polysiloxanes; heterogeneous catalysed polymerization
- siloxane containing block and graft copolymers (siloxane-vinyl, amide, ester, carbonate, alkylene oxide, pyrrole, sulfone, N-acyliminoethylene)
- siloxane elastomers, protective coatings, adhesives

Heteroatomic monomers, thermally stable and flame resistant polymers

- monomers and polymers with maleimide structure
- flame resistant and thermally stable compounds with P, halogen, S and N atoms
- heterocyclic, cross-linkable polyamides
- direct synthesis of polyamides, polyesters, polyhydrazides, polyureas and copolymers from monomers with leaving groups (S, B, F)
- thermally stable polymers (imide polymers and copolymers, aromatic amide polymers and copolymers)
- aromatic polysulfones

Urethane polymers

- kinetics and mechanism of polyurethanes synthesis starting from 4,4' – dibenzyldiisocianate
- parabanic polymers and copolymers
- binary and ternary urethane copolymers
- urethane ionomers (cationomers, anionomers and zwitterionomers)

Linear and non-linear polyelectrolytes

- synthesis and characterization of ion exchangers
- interaction of polyelectrolytes with metal ions, organic and inorganic compounds, dyes, flocculants
- interpolyelectrolyte complexes
- polyelectrolytes in ecological and biomedical applications

Unconventional polymer synthesis methods

- electroactive polymers (conjugated polyazomethines, polyvinylenes, polyaniline and polypyrrole)
- plasma chemistry (thin films, prebiotic chemistry: the origins of life)
- cross-linking of polymers by radical/cationic photochemical reactions

- transparent layers of conjugated azo-aromatic polymers obtained by photolysis and/or thermolysis of aromatic diazides; photoconduction properties
- kinetics of trans-cis photoisomerization and cis-trans thermal recovery of azobenzene and cinnamate chromophores incorporated into poly(vinyl chloride) and styrene – maleic anhydride copolymers
- magnetic or electric field polymerization of vinyl monomers; adhesives

II. Chemical modification of natural polymers. Bioactive and biocompatible polymers

Bioactive and biocompatible polymers

- maleic anhydride based copolymers
- functionalization of extracellular microbial or native polysaccharides, cyclodextrins, cellulose and polyhydroxyalcanoates
- natural polymers/bioactive substances (drugs) conjugates with controlled release
- bile acids
- cationic polysaccharides interactions

Chemically modified celluloses. Biomass valorification

- physical (extraction), chemical and/or biochemical modification of biomass components
- enzymatic hydrolysis of cellulose
- polyphenols
- lignin - synthetic polymer blends; composite materials based on wood derivatives and synthetic polymers obtained by “in situ” polymerization
- synthetic polymer resins

III. Polymer characterization. Characterization of polymer solutions. Compatibility, characterization of polymers in solid state

- investigation of mechanical, electrical and thermal properties of materials, electrical conductivity and photoconductivity as well as of the behaviour under heat, light and electric field, to provide information on the lifetime of materials and their impact on the environment
- methods to control the quality of industrial products
- methods to study natural polyelectrolytes (nucleic acids, proteins or ionic polysaccharides), to provide information for life sciences (molecular biology, microbiology and virusology), pharmacy and medicine. This topic was quite recently promoted in view of finding new high performance polymers for gene delivery systems based on maleic polymers.

IV. Environment protection and energy conservation

- new, clean sources of energy, by using maleic polyelectrolytes as antiscale agents in the exploitation of geothermal water
- the management of soils and the enhancement of agricultural production through soil conditioners based on maleic acid copolymers
- reduced eutrophication of waters through maleic polyelectrolytes as phosphate substitutes prevention of pollution with chromium (tanning processes)
- polymers for waste water treatment, purification of biological liquids
- protecting of the environment against pollution by polymer waste resulted from industrial and household activities
- short-term or controlled life time polymer materials, to reduce the amount of natural waste residues and to remove the generated waste by destructive procedures as pyrolysis

Available research infrastructure :
Large buildings (3,000 m^2, with organic/polymer chemistry and polymer physics laboratory, a conference hall, library, exhibition spaces, pilot scale installations).

Main equipment : Bruker Avance DRX 400 NMR Spectometer, Scanning Probe Microscope (Solver Pro-M), Perkin Elmer Diamond Dynamical Mechanical Analyzer, Perkin Elmer – Pyris Diamond Differential Scanning Calorimeter, Perkin Elmer 2400 Series II CHNS/O Analyzer, Bruker D8 – Advance X-ray Diffractometer, Bruker 70 Vertex Spectrophotometer, as well as equipments for the analysis and characterization of nano- and microparticles.

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